

### ASPECT CUBESAT MISSION TO A BINARY ASTEROID DIDYMOS.

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**Introduction:** ASPECT (Asteroid Spectral Imaging Mission) is a part of AIDA/AIM project and aims to study the composition of the Didymos binary asteroid and the effects of space weathering and shock metamorphism in order to gain understanding of the formation and evolution of the Solar System.

**AIDA mission:** The joint ESA/NASA Asteroid Impact & Deflection Assessment (AIDA) mission (Fig. 1) to the binary asteroid Didymos consists of the Asteroid Impact Mission (AIM) by ESA and the Double Asteroid Redirection Test (DART) by NASA. DART is targeted to impact the Didymos secondary component (Didymoon) while AIM monitors the impact effects. This will demonstrate the use of a kinetic impactor to deflect potentially hazardous asteroids. Both spacecraft will be launched in 2020 and will arrive to Didymos in 2022.

**ASPECT mission:** The AIM mission will also include two CubeSats, which will be released around Didymos. This opens up a possibility for secondary scientific experiments. ASPECT is one of the proposed CubeSats.

**ASPECT objectives:** ASPECT is a 3U CubeSat equipped with a spectral imager and it will be used to measure the spectral characteristics of the impact site before and after the DART impact, as the impactor should bring fresh material to the surface. This gives a unique opportunity to study space weathering effects on asteroids.

ASPECT will also demonstrate for the first time the joint spacecraft – CubeSat operations in asteroid proximity and miniature spectral imager operation in deep-space environment.

#### *Science objectives:*

- Map the surface composition of the Didymos system.
- Photometric observations and modeling of the Didymos system under varying phase angle and distance.
- Evaluate space weathering effects on Didymoon by comparing mature and freshly exposed material.
- Identify local shock effects on Didymoon based on spectral properties of crater interior.
- Observations of the plume produced by the DART impact.
- Map global fallback ejecta on Didymoon and Didymain.

#### *Engineering objectives:*

- Demonstration of CubeSat autonomous operations in deep space environment.
- Navigation in the vicinity of a binary asteroid.
- Demonstration of a satellite survival during impact.
- Demonstration of joint spacecraft – CubeSat operations.
- Demonstration of spectral imaging of asteroid materials.

**ASPECT configuration:** ASPECT is an autonomous 3U CubeSat ( Fig. 1) equipped with a VIS-NIR spectral imager from 500 nm to 1600 nm (spatial resolution < 2 m, spectral resolution 10 – 30 nm) and a non-imaging SWIR spectrometer from 1600 – 2500 nm. The design is based on the Aalto-1 CubeSat Spectral Imager heritage. ASPECT will also demonstrate the capabilities of a CubeSat and a miniature spectral imager in deep-.

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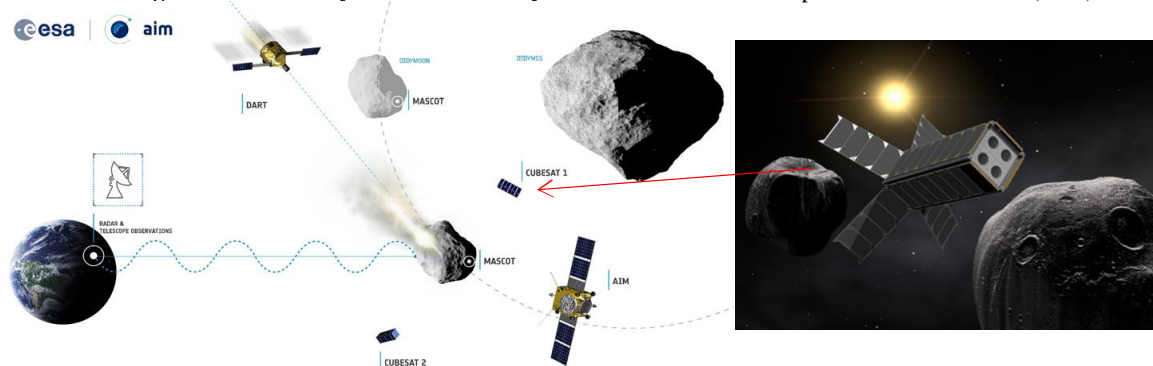


Fig. 1. AIDA mission scenario (left) and illustration of ASPECT satellite (right).